

# Novel Concepts For Radiation Shielding Materials Project

Center Innovation Fund: KSC CIF Program

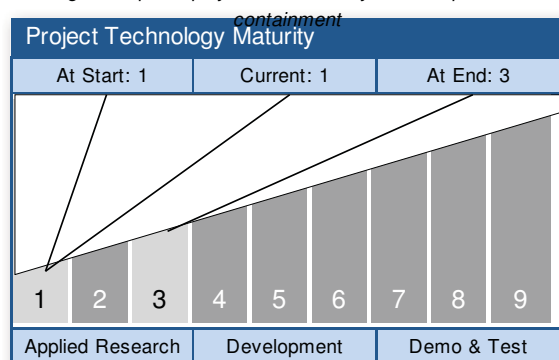
Space Technology Mission Directorate ( STMD )

National Aeronautics and  
Space Administration

## ABSTRACT

It is critical that safety factors be maximized with respect to long duration, extraterrestrial space flight. Any significant improvement in radiation protection will be critical in ensuring the safety of crew and hardware on such missions. The project goal is to study novel concepts for radiation shielding materials that can be used for long-duration space missions. As part of this project we will investigate the use of thin films for the evaluation of a containment system that can retain liquid hydrogen and provide the necessary ...***Read more on the last page.***

Joining concept for polymer laminate system for possible H2 containment



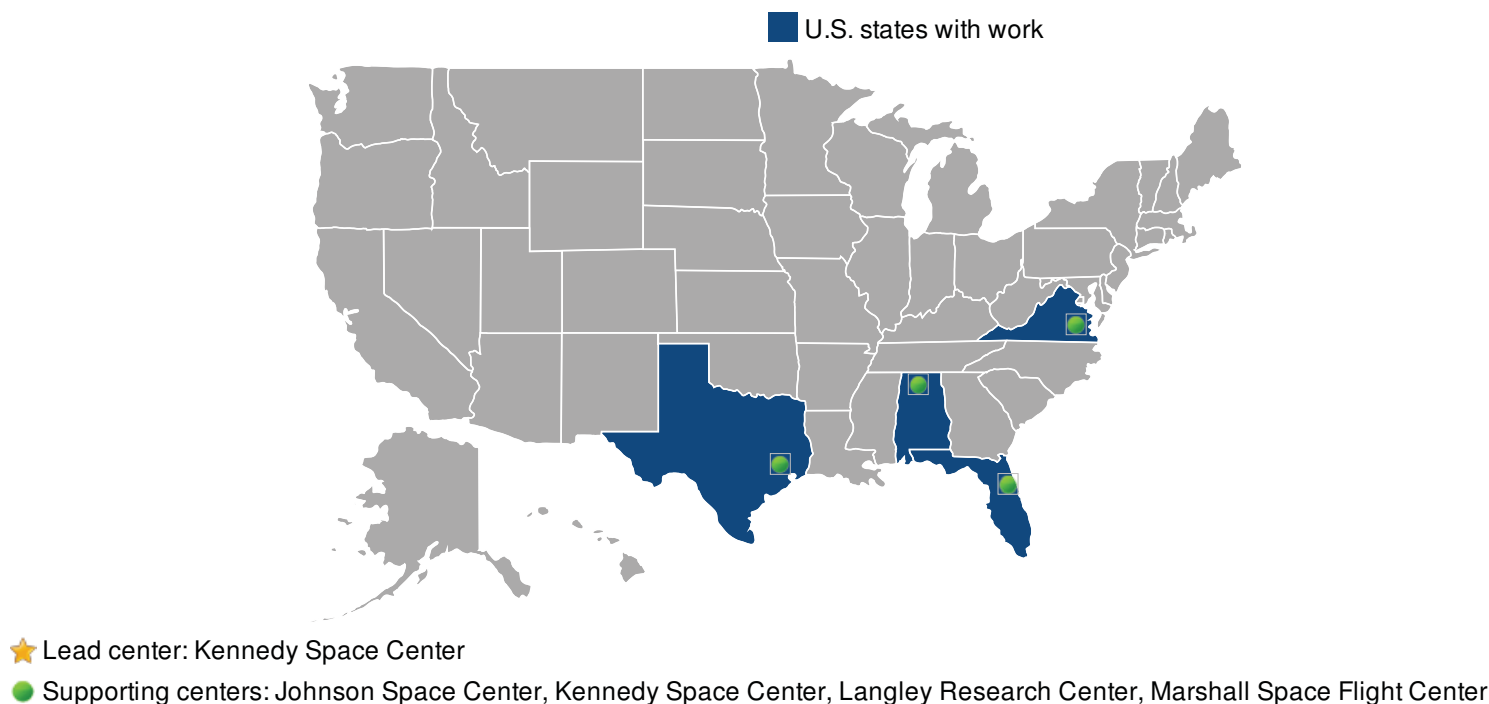
Technology Area: Space Power & Energy Storage TA03 (Primary)  
Human Health, Life Support & Habitation Systems  
TA06 (Secondary)

## ANTICIPATED BENEFITS

### To NASA funded missions:

As more advanced and prolonged human exploration of environments beyond earth are being considered, it is recognized that radiation protection will need to be optimized in order to safely carry out these missions. Even if only a marginal improvement in protection was observed by some of the concepts studied and light weight hydrogen containment could be realized and advanced, such an increase in protection could mean the difference to mission success or ...

Read more on the last page.



## DETAILED DESCRIPTION

The technical challenge of this project was to identify or design/develop a polymeric/composite material, laminate system that can contain a large quantity of liquid hydrogen in deep space for Galactic Cosmic Radiation (GCR) shielding. This material/system must be strong enough to handle the pressure generated by this cryogenic material, yet maintain some degree of elasticity, even at liquid hydrogen temperatures (typically 20 K). It must be thin enough to minimize secondary particles from GCR, yet not allow the hydrogen to diffuse through it. Finally, it would be desirable to have high emissivity at long wavelengths so that radiative cooling can occur. Specific architectural designs and thermal controls of hydrogen contaminant system was not addressed in this project. This project also aligns with joint activities currently being worked with other NASA centers and the integration of technologies that are considered necessary for future exploration.

### MANAGEMENT

**Program Director:**  
Karen Thompson

**Program Executive:**  
Burton Summerfield

**Program Manager:**  
Nancy Zeitlin

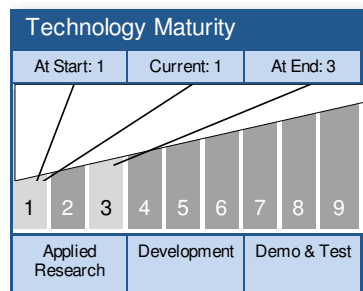
**Project Manager:**  
Nancy Zeitlin

**Principal Investigator:**  
Martha Williams

**Co-Investigator:**  
Robert Youngquist

## TECHNOLOGY DETAILS

### Novel Concepts for Radiation Shielding Materials



### TECHNOLOGY DESCRIPTION

Radiation shielding is a top technology need for Deep Space Exploration. One of the most feasible material for protecting against Galactic Cosmic Radiation (GCR) in deep space is liquid hydrogen, but it must be contained with minimal mass and in containers that will not produce secondary radiation.

This technology is categorized as a material for other applications

- Technology Area

- TA03 Space Power & Energy Storage (Primary)
- TA06 Human Health, Life Support & Habitation Systems (Secondary)
- TA07 Human Exploration Destination Systems (Additional)
- TA12 Materials, Structures, Mechanical Systems & Manufacturing (Additional)

### CAPABILITIES PROVIDED

If concepts addressed proved successful and lead to architectural designs, an observable increase in GCR protection could be realized and the advancement of these concepts could substantially increase the safety of long term extraterrestrial activity. If reduced to practice, cryogenic polymer containment systems for liquid hydrogen could provide potentially a factor of 3 reduction in shield mass over a water based radiation shield. Increased radiation protection using liquid hydrogen shielding could also potentially extend deep space GCR exposure limits beyond the current limit of 3 months.

Liquid hydrogen containment designs could also be applicable to future space flight cryogenic propellant storage and transfer.

## IMAGE GALLERY

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Joining concept for polymer laminate system for possible H2 containment

## ABSTRACT (CONTINUED FROM PAGE 1)

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hydrogen density for effective shielding.





## ANTICIPATED BENEFITS

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### **To NASA funded missions: (CONT'D)**

failure.

### **To NASA unfunded & planned missions:**

Significant benefit could be expected by leveraging several different NASA centers' radiation shielding activities and how they might be applicable to an integrated approach.

### **To other government agencies:**

The proposed advances in radiation shielding are also applicable to non-space applications such as military operations.

### **To the commercial space industry:**

Potential Customers: Human Exploration and Operations Mission Directorate, Science Mission Directorate, Department of Energy, and the military. Potential for Follow-on Funding: Human Exploration and Operations Mission Directorate, Department of Defense, Homeland Security, Department of Energy, and Science Mission Directorate.

### **To the nation:**

The concepts addressed in this technology, if successful, should find applications in other radiation protection fields such as medical shielding, nuclear power, etc.